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ABSTRACT

Twenty-four beginning readers participated in a study of the effectiveness of cued learning. The study was carried out in two phases--a letter-learning phase and a word-learning phase. The children were taught one at a time by the same teacher over a four-year period. During the word-learning phase, one fourth of the children used a vowels-only color code, one fourth used auditory-to-visual (AV) spelling cues, one fourth used both, and one fourth used neither. Results indicated that the groups using color coding made significantly fewer errors when reading colored vowel combination and nonphonetic words, but not short vowel words and not when transferring to black nonphonetic words and when decoding words not previously taught. The children using spelling cues made significantly fewer errors when reading black vowel-combination words. Neither the color coding nor the spelling cues impeded transfer to uncued words. First encounter spelling errors were significantly more numerous than reading errors in words previously taught and significantly less numerous than first encounter reading errors. (Appendixes contain lesson plans and vowel games, and lists of colors, keywords, and pictures used in the study.) (FL)

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COLOR-CODED VOWELS AND SPELLING WITH VISUAL CUES IN BEGINNING READING

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of the Master of Arts Degree In Reading Specialization
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ABSTRACT

In two experiments on cued learning, beginning readers learned a vowels-only color code and constructed words with movable letters that provided visual spelling cues. All groups were trained in both colored and black vowels, with colors that mnemonically linked vowels and keywords. The color groups made significantly fewer errors when reading colored vowel-combination and nonphonetic words but not short-vowel words and also when transferring to black nonphonetic words and when decoding words not previously taught. The children using spelling cues made significantly fewer errors when reading black vowel-combination words. Neither experimental condition impeded transfer to uncued words. First-encounter spelling errors were significantly more numerous than reading errors in words previously taught and significantly less numerous than first-encounter reading errors.

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While the National Assessment of Educational Progress (1975) revealed an improvement in the test scores of nine-year-olds and a researcher like Diedrich (1973) believes that studies of beginning reading should be curtailed in favor of higher levels of reading, few would claim that problems of beginning reading have been eliminated, especially for learning-disabled children.

Among these problems is the fact that neither phonetic nor controlled-vocabulary programs have the ideal reading vocabulary for beginners. On the one side is the artificial, look-alike vocabulary of the phonetic readers, with what is often an early introduction of difficult short-vowel/consonant-blend words, and on the other side is the prevalence of multiple-vowel spellings and nonphonetic words in any story told in a natural vocabulary. While most children transcend these difficulties, learning-disabled children often have a long wait before they can read stories that are at all interesting to them. Color codes (Gattegno, 1962; Bannatyne 1966) are attempts to solve these problems, but they involve the preparation of special materials and raise questions about transfer of learning that can't be answered without research into beginning reading.

Investigators who evaluated Gattegno's Words in Color did not examine the use of color as a mnemonic link between letters and their pronunciation, nor did they examine the difference between an all-letters code like Gattegno's and a vowels-only code like Bannatyne's. For these reasons, further studies of color coding are still needed.

Moreover, studies which concentrate on evaluating methods for decoding individual sounds are incomplete unless they extend to alternative procedures for helping children use the sounds they have decoded. Children who have formed sound-symbol associations but who can't blend and sequence these sounds in figuring out words will perform as poorly as children who blend well but who have not acquired these rote associations. The first is a problem of word technique, while the latter is a problem of letter technique.

In addition, some children can recognize and label letters and letter groups in isolation but not when they are embedded in words, while others can fill in the gaps and correctly identify words for which some of the letters are imperfectly labeled. In fact, the latter situation is what facilitates transfer to black and white from a color code and to traditional orthography from i.t.a., especially with nonphonetic words. If reading methods are evaluated globally without separating the issues of letter technique and word technique, it is impossible

to isolate those elements of a method that are useful for particular children.

In this study, an attempt was made to test the effectiveness of a color code of thirteen colors, for vowels only, when teaching color-coded words to beginning readers. The control groups read words with black letters. Also tested was the use of visual spelling cues for developing word technique. Using this method, the children constructed their words out of letter-cards before reading them. The control groups, who did not spell their words, were taught by a synthetic, guided-sounding approach.

DEFINITION OF TERMS

Color-coding is a way to reduce the number of sound-symbol associations that must be memorized and a way to make all words phonetic, by having each sound represented by one color no matter how that sound is spelled. In a color code, the ir in girl, the er in fern, the ur in church, the ar in cellar, the or in worm, and the ear in pearl all share the same color, which provides a consistent cue for their sounds and also chunks the vowels in each vowel-combination into a single entity. Thus the ou in soup will have the same color as the oo in pool, the ew in blew, and the ue in blue but a different color from the ou in loud, although, or rough. In the Gattegno code, an all-letters code, the s in rose

is the same color as the z in zoo, while the code in this study, like the Bannatyne code, is for vowels only (with respellings for irregular consonants written above the consonants they translate). Thus color codes are similar to modified alphabets like i.t.a. in both function and rationale, except that spellings and letter-forms remain unchanged.

To distinguish this color code, which was devised in 1965, from the Gattegno and Bannatyne codes, it has been called the Thirteen Code, since it is a code of thirteen colors.

The spelling approach used in this study is called auditory-to-visual spelling or A-V spelling. A-V spelling involves spelling a word from letter-cards that are laid in front of a pupil so that he hears the word he is to spell (auditory), then chooses from multiple-choice clues (visual) which of the letters before him are to be used. (The words cues and clues are used interchangeably.) Thus this spelling is at a recognition rather than a retrieval or total-recall level, since total-recall spelling does not include visual clues.

For example, the letters for man, fat, hop, and hot are:

f a n
m o t
h p

The letters are put on cards so that the child can arrange the letters himself on a "beginning-middle-end" card with boxes

for each letter. Coloring the backs of the cards makes a game, so that a word "wins" if all three cards have the same color. When the reading of a word is rehearsed after first being encountered through A-V spelling, the letter-sound associations and letter-patterns are still fresh in the child's mind, so that he can usually read it correctly even if he would not be able to read the same word correctly after a time lapse. Four or five words are spelled with cards before the "read-back" to make sure that the words are read rather than echoed.

A synthetic, guided-sounding approach was used with the control groups, who did not use A-V spelling. This approach involved working with the same letter-cards (with colors on the back for the game) and the same beginning-middle-end card. However, for the A-V groups the letter cards were simultaneously visible to choose from. The cards were not visible for the non/A-V groups but were laid down one at a time by the teacher when each word was being sounded. Thus the separation or segmentation of the individual sounds was emphasized by having each letter or vowel-combination on a separate card, but the auditory-to-visual element was removed.

SUB-PROBLEMS

In testing color-coding, it is necessary to take into account the differences between the different codes. The Gattegno code (1962) includes colored consonants, whereas the Bannatyne

code (1966) and this code keep consonants black. Moreover, the codes require different amounts of memorizing: forty-seven colors in the Gattegno code, seventeen in the Bannatyne code, and thirteen in this one. The latter two are built on a keyword system, so that letter-sounds are connected mnemonically to their letters through keywords (color-names in the Bannatyne code and colored keyword-pictures in this one), whereas the Gattegno code does not include keywords. However, the published research on color-coding seems to be on the Gattegno rather than the Bannatyne code, so that color-coding with a mnemonic element does not appear to be adequately tested.

Another sub-problem is that of global scores. If only over-all scores are recorded, it is impossible to determine if color-coding is more useful for some types of words than for others. Therefore, the words in this study were broken down into three groups: short-vowel words, vowel-combination words, and nonphonetic words, with separate sub-scores for each.

Another issue is that of errorless learning, because the purpose of cued learning, whether it takes the form of color-cues or spelling cues, is to reduce errors in the initial stages of learning. With errorless learning come questions with hard-to-quantify answers about the attitudes of learners and the willingness of teachers to prepare "errorless" materials.

DELIMITATIONS

The four approaches to beginning reading described in this study deal only with decoding and not with comprehension or interpretation of what has been decoded, and the approaches are all phonetic. The issue here, then, is not whether a phonetic or a sight method is more effective but rather which of four phonetic methods is most effective.

While children who can already read are no longer appropriate subjects for an investigation like this, it was also necessary to restrict it to children who were ready to begin reading instruction. Thus the subjects of this study fell into that narrow band on the continuum between reading and non-reading usually called readiness.

For the sake of simplicity, tracing, writing, and naming letters were not included, so that long vowels, which involve letter-naming, and the reversible letters b and d, which often require tracing and writing, were excluded from the list of words taught to the twenty-four children.

ASSUMPTIONS

When reading, a child recognizes the visual stimulus, the spelling of a word, but must retrieve the sounds from his memory bank. When spelling, he recognizes the auditory stimulus, the sound of a word, but must produce the spelling, retrieving the name, the form, or the kinesthetic image of each letter from his memory bank. With A-V spelling, however, the letters to be used

are visible, so recognition rather than retrieval is necessary. Similarly, the sounds are heard and recognized, not retrieved as they are in reading. Thus both visual and auditory recognition rather than recall or retrieval is needed to do A-V spelling.

The assumption here is that recognition is easier than recall or retrieval and that, apart from auditory discrimination, the recognition factor in A-V spelling makes it easier than both reading and total-recall spelling. What is open to question is whether A-V spelling facilitates sounding and blending and thereby speeds up the learning-to-read process in children this age or whether it is a superfluous step in teaching non-remedial children, who may be able to make the leap from letters to words without this intermediate step.

PROCEDURE

The experiment was in two phases, a letter-learning phase of eight lessons and a word-learning phase of seven lessons, during which twenty-four words were taught to twenty-four children, twelve Kindergarten girls, eight Kindergarten boys, and four non-reading first-grade boys. The children were taught one at a time by the same teacher over the course of four years. During the word phase, one fourth of the children used colored vowels, one fourth used auditory-to-visual (A-V) spelling clues, one fourth used both, and one fourth used neither. The non/A-V groups used regular, synthetic decoding.

In an attempt to eliminate the problem of overdependence on secondary color-cues, the children in both color-code and non-color groups were trained in both the colors and the forms of the vowels. Also, during the word-training phase, the color groups practiced letters without colors and colors without letters rather than colored letters, while the black-print groups practiced black letters.

For the letter phase, all twenty-four children learned (or reviewed) the sound-symbol associations for the fourteen consonants included in the twenty-four words and, in addition, learned the sounds and colors for thirteen vowels and vowel-combinations, twelve of which were needed for the words. Short e was taught with the other short vowels but was not tested or used in any of the words, while the long vowels and their color were not included in the experiment.

The consonants were taught or reviewed through games, in which each consonant was matched to a keyword picture with the letter embedded in the picture to provide a mnemonic connection between its shape and its keyword. The consonants were not color-coded. The vowels and vowel-combinations were also taught through keywords, using the Gillingham procedure of saying first the keyword, then the sound, in an echo relationship to the keyword (Gillingham and Stillman, 1956). Keywords were memorized through a picture-matching procedure, whereby the children matched

black keyword pictures to colored letters, using for reference a composite picture with all the keywords colored to match the color-coded letters. Thus a child matched a black apple to a red a, referring when necessary to the picture of the red apple on the composite card. The picture-matching was followed by games with colored letters.

Later, for the transition to black vowels, black vowels were matched to keyword pictures with embedded letters similar to those used for the consonants. Redundant cues were acquired when a child first learned that the brown or went with the brown horse and later that the o was the horse's big, round eye looking at the r, which was a rainbow. Then games were played with black letters, crayoned color swatches, and black keyword pictures to facilitate the transition to letters without colors and colors without letters, the latter being necessary for translating nonphonetic words, in which one has to "obey the color."

Thus training was in letter shapes and vowel spellings as well as colors for all the children, both color and black groups. Then, during the word phase, all twenty-four children practiced the vowels in black each lesson, while the twelve children using color-coded vowels practiced the colors as well, using crayoned color swatches. Thus the group whose words had colored vowels practiced both letters without colors and colors without letters but did not practice colored letters, while the group whose words had black vowels

used the color code for learning their vowels but did not use the colors during the word phase.

After completion of the letter phase, the children were post-tested on the consonants and vowels and then blocked according to age and vowel scores and divided into four treatment groups in a two-by-two factorial design. With the two independent variables of color and auditory-to-visual spelling (A-V spelling), the four groups recevied the following treatments:

Group 1 - colored vowels and A-V spelling

Group 2 - colored vowels and no A-V spelling

Group 3 - black vowels and A-V spelling

Group 4 - black vowels and no A-V spelling

All four groups had the letters for their words on separate cards (and thus pre-segmented), with the backs of the cards colored to provide a game. (A word with matching colors "wins.") The A-V groups spelled their words with the letter-cards before reading them and had the letter-cards simultaneously visible to provide spelling clues and to keep spelling at the recognition level rather than the retrieval or total-recall level. This way they heard each word (auditory), then chose, multiple-choice style, the spellings from visible letters (visual) in an auditory-to-visual process. After spelling the words of a word-set, they did a "read-back," reading the four words they had just spelled while the words were still fresh in their minds.

The non/A-V groups also had their letters on separate cards so that the auditory-to-visual factor could be isolated. Thus the words were not introduced to the non/A-V groups in one piece (as they are on flashcards and in books) but rather were pre-segmented on separate letter-cards. The reason was that the A-V groups, having a concrete representation of the letter segments because of the letter-cards, might have performed differently from the non/A-V groups in a way that had nothing to do with a first encounter by the auditory-to-visual route. Also, it was possible this way for all the groups to play the color-matching game. Therefore, the non/A-V groups learned their words with separate letter-cards, except that the words were presented through a synthetic, guided-sounding approach, rather than through spelling, with the teacher laying down the letter-cards one at a time. Each set of four words was made twice so that the children would have the same number of encounters with each word as the A-V groups.

A word-matching game, with the words in one piece on five-by-eight cards, provided a third encounter during the same lesson for all four groups. In addition, the teacher said each word in a sentence during first encounters, and all the children were helped with blending and segmenting (peeling off the sounds in the words that were spelled) when they needed help but were allowed to work out their words independently as much as possible.

Two word-sets at a time (eight words) were practiced for two consecutive lessons, then posttested during the third. This way the children had only six encounters with each word before testing (two spelling and four reading for the A-V groups and six reading for the non/A-V groups). With more encounters, more children might have memorized more words, but the number of encounters was limited to make it easier to discriminate among treatments.

Posttesting included twelve untaught words using the same vowels and consonants. In addition, the color groups were tested on their words in black as well as color, so they weren't told during the posttest if a colored word was right or wrong. They were not given any special practice in transferring to black words before the test in black but were given the same opportunity as the black groups to practice the vowels in black.

Since handling different kinds of vowels presents different problems that can't be analyzed when they are lumped together, the words were divided into the following categories, with four words in each word-set or pack:

A, B, and A' packs - short-vowel words

C, D, and C' packs - vowel-combination words

E, F, and E' packs - nonphonetic words

A', C', and E' packs - untaught words

A one-way analysis of variance was based on the total number of words correctly read by the children in each of the four treatment groups and also on the total number of words correctly read in each of the above phonetic categories. For the color groups, testing was in both color and black.

In addition, a comparison was made between the first-encounter spelling of the children in the A-V groups and their posttest reading of both taught and untaught words. The first-encounter spelling score was based on the ability of each child to segment the sounds and thus to spell a word which the teacher pronounced twice (and said in a sentence) without needing help in isolating or peeling off the separate sounds or in choosing the correct letters. For the first two word-sets, scores were taken from the second lesson so that the children could learn the procedure in the first lesson.

SUBJECTS

The twelve boys and twelve girls were enrolled in both a public school and a private school and came from the Kindergarten during four consecutive years and from one first grade to allow for the small number of children that could be taught at one time. Three boys and four girls were from a middle-class, suburban public school, while eight Kindergarten girls, five Kindergarten boys, and four first-grade boys were from a private school. Because the children from the public school were no longer

available after the first year of the experiment, the block of three public-school, Kindergarten boys was filled by a private-school, Kindergarten boy, but the other blocks were matched by school, grade, sex, the year in which they were taught, and classroom teacher (although classroom teachers did not participate in the experiment).

Before starting the letter-training lessons, each child was pretested on the criterion list of twenty-four words, so that children who were already reading could be eliminated from the experiment. A few of the girls were able to read a few of the short-vowel words, but they were counterbalanced among the four groups. None of them was able to read the vowel-combination or nonphonetic words.

The children were also given the Jansky-de Hirsch Screening Index for Kindergarten children (Jansky and de Hirsch, 1972), which consists of the following five subtests in order of predictability: Letter Naming, Picture Naming, Gates Word Matching, Sentence Memory, and Bender Motor Gestalt (six figures). In addition, they were given a modified version of the Roswell-Chall Auditory Blending Test as it appears in the Jansky-de Hirsch Diagnostic Battery, which accompanies the Screening Index. They were also tested for color perception through playing a dominoes game with the thirteen colors of the color code. Two of the boys proved to be color-blind and were assigned to the two black groups.

The Jansky-de Hirsch Screening Index screens Kindergarten children who are likely to fail by the end of second grade and is not meant to predict success in Kindergarten reading, but it was used in this study to eliminate children who were likely to fail in second grade and would therefore be still less likely to succeed in Kindergarten reading. Also, the five subtests are predictive in combination (through multiple-regression analysis) rather than in isolation, so that a rating of "poor" on one or two subtests does not necessarily predict failure by the end of second grade. Nevertheless, a child with a rating of "poor" on two or more of the subtests was not included in this experiment even if his score for the total index was above fifty, under the assumption that success during the word-phase for a Kindergarten child would be more likely with no "poor" scores or only one. (It takes each school several years to establish its own cut-off scores for the total screening index, based on the school's methods and expectations, but scores below fifty become increasingly suspect, especially for boys.)

The other way to determine inclusion in the experiment was by scores on the posttest for vowel letter-sound associations at the end of the letter phase. For this test, colored vowels were tested during one lesson, while black letters and color swatches were tested during the next. Twelve vowels and vowel-combinations (long vowels and short e not included) were tested in each of the three

ways, resulting in a total of thirty-six responses.

From the vowel letter-sound tests, there were two ways to determine readiness for the word phase: one, the letter-phase could be open-ended, so that each child would reach a criterion in letter-sound associations before starting the word phase; or two, children who could not reach the criterion in eight lessons would not be included in the word phase. Under the first option, the children would be blocked according to the number of lessons needed to reach the criterion, while under the second, they would have to pass the criterion measure to be included and would be blocked according to their scores on the criterion test. School schedules made the first option impossible, so a limit of fifteen lessons, with eight for the letter phase, and a criterion measure for inclusion in the word phase were established.

After preliminary testing with a pilot group of six children, a cut-off was determined of more than three errors on the vowel letter-sound posttest for children with a "poor" score on the screening index. However, to increase the number of available subjects, children with no "poor" scores were included even if they missed more than three of the letter-sound associations. The number of errors was then counterbalanced as much as possible among the four treatment groups. A child who was excluded from the experiment continued to have the same number of lessons as the others, with a modified program, so no child was aware of being

included or not.

Assignment to the four treatment groups was randomized when possible, but priority was given over randomization to counterbalancing the groups as much as possible by age and by scores on the posttest for letter-sound associations. Because of the small number of children, perfect counterbalancing was not possible, but inequalities favored the nul hypothesis, since the

TABLE I

AVERAGE AGES AND ERROR SCORES IN VOWEL SOUNDS

	Color/A-V Group	Color/No A-V Group
Average age	5 yrs., 8.83 mos.	5 yrs., 9.17 mos.
Average vowel-error scores	2.67 out of 36	2.83 out of 36
Average age	5 yrs., 10.5 mos.	5 yrs., 10.17 mos.
Average vowel-error scores	2.3 out of 36*	2.3 out of 36*

*One error was extrapolated onto the total error scores of each of the black groups for the two color-blind boys, each of whom made two vowel errors when taking two of the three vowel letter-sound tests. (They were tested on the colored vowels and on the black vowels but didn't take the color-swatch test.)

color groups were slightly younger and had slightly higher vowel-error scores than the black-print groups. All of the children achieved 100% mastery of the fourteen consonants.

Although the blending test is part of the Diagnostic Battery and not part of the five-subtest Screening Index, blending would seem to be a relevant skill for an experiment in decoding, so the blending test was given in addition to the five regular subtests. As Table 2 shows, the average blending score is lower for the

TABLE II

SCORES ON TEST OF BLENDING*
N=6 in each cell

	Color/A-V Group	Color/No A-V Group
Average blending score	75%	61.7%
Number of "poor" scores (0% or 10%)	one child	-----
	Black/A-V Group	**Black/No A-V Group**
Average blending score	71.7%	71.7%
Number of "poor" scores (0% or 10%)	one child	-----

*Modified version of the Roswell-Chall Test of Blending as it appears in Jeannette Jansky and Katrina de Hirsch, Preventing Reading Failure, New York, Harper and Row, 1972.

Color/No A-V Group than for the others, while each of the two A-V groups has one "poor" rating for blending. (The blending test consisted of ten items.) Perfect counterbalancing would have been preferable, but there were not enough children to allow for symmetry.

Another way to counterbalance the groups was according to scores on the subtests of the Screening Index. There were no "poor" scores for Letter Naming (six capital letters), Picture Naming, or the Bender among the children included in the experiment, but one child in the Color/A-V Group had a "poor" Word Matching score, and two children in the Black/A-V Group had "poor" Sentence Memory scores. Thus counterbalancing was not achieved for Word Matching and Sentence Memory, but the children were fairly well counterbalanced for age, letter-sound scores, and blending.

APPARATUS FOR THE LETTER PHASE

Matching-games were used for practicing both consonants and vowels. The games are similar to Go Fish except that the cards are laid on the table and not held in the hand ("You can see mine, and I can see yours") and taking a book does not entitle one to another turn (to avoid winning streaks).

Each book in the consonant games consisted of one card with a plain letter and one card with the letter embedded in its keyword-picture. The consonants were divided into the following four games,

the fourth of which was saved for the last two lessons and included six of the seven consonants not used in the experiment (x was not included):

Game 1 - f, h, m, p, t

Game 2 - c, g, n, r, s

Game 3 - k, l, v, w, h (h was repeated)

Game 4 - b, d, j, q, w, y, z (w was repeated)

Four composite pictures with the consonants embedded in their keyword-pictures were used for reference, with one composite picture for each of the four games.

Materials for teaching the vowels were all on cards and included color-coded vowels, black vowels, and crayoned color-swatches on three-by-five cards and black keyword-pictures on three-by-five cards cut in two. In addition, a composite picture with all the keywords colored to match the color-coded vowels was used for reference. There were no letters embedded in the keyword pictures, since the keywords were connected mnemonically with the vowels by color rather than by shape during the first few lessons with the vowels. The colored vowels and the pictures were for the letter phase, while the black vowels and the color-swatches were for the word phase.

The same variation of Go Fish was used for practicing the vowels. The first set of three games involved matching three color-coded letters; the second set of three games involved

matching black letters to cards with the vowels or vowel-combinations embedded in color-coded keyword-pictures; and the third set of two games involved matching black letters, crayoned color-swatches, and black keyword-pictures. The first and third sets had three cards to a "book," and the second set had two cards to a "book."

Each set of games was divided into the following three groups, and only one group of letters was taught (or practiced through games) at one time:

short vowels - a, e, i, o, u (Short e was taught but was not included in the experiment)

vowel plus r - ar, ir, or (This group was combined with the short vowels in the third set of games)

vowel-combinations - ow, oy, oo (both sounds), and al (with the silent l circled because it was a "ghost letter")

Three composite pictures, one for each of the three groups, were used for reference when playing the vowel games with the black letters. These had the vowels and vowel-combinations embedded in their keyword-pictures, which were also colored according to the color code, thus providing redundant cues.

APPARATUS FOR THE WORD PHASE

The twenty-four words were taught in word-sets of four words, with two word-sets (and thus eight words) introduced at a time. The words were divided by the following phonetic categories:

A, B, and A' packs - short vowels

A - man, fat, hop, hot

B - sit, pig, rug, sun

A' - hug, fit, ran, mop (untaught words)

C, D, and C' packs - vowel-plus-r and vowel-combinations

C - how, toy, too, car

D - talk, fork, girl, cook

C' - now, far, horn, took (untaught words)

E, F, and E' packs - nonphonetic

E - soup, pull, warm, work

F - love, come, move, lost (silent e's circled)

E' - suit, cost, some, worm (untaught words)

The word-sets were taught through packets of letter-cards for building the words letter by letter (through either A-V spelling or synthetic sounding) and packs of word-cards for playing a word-matching game and for posttesting the words.

Both the A-V and the non/A-V groups read or spelled their words with letter-cards, which were arranged on a "beginning-middle-end" card, a tagboard strip five by fourteen inches, with three large boxes for structuring the words and the center box

outlined in color to show that it was for vowels. On the other side were two boxes for the two-card words in word-set C (how, toy, too, car). A second tagboard strip, also five by fourteen inches, was used only for the A-V groups. This strip, which was also outlined in color to show it was for vowels, was placed over the middle (vowel) box on the "beginning-middle-end" card in an inverted "T" and was used as a "color-path" for the vowels. The consonant cards for the A-V groups were arranged before and after the vowel path in the beginning and ending positions. This way all the spelling clues were visible for the children doing auditory-to-visual spelling, and the letters were arranged in beginning, middle, and ending positions.

The letter-cards for all twenty-four words (divided into six packets for word-sets A through E) consisted of black consonants for all the children, colored vowels for the color groups, and black vowels for the black groups. The backs of the cards were colored so that the children could turn over the cards to see if a word would "win," a winning word being one with the same color on all three cards. The cards were colored so that either one or two words in each word-set would be a winner.

The letter-cards for word-sets E and F (the nonphonetic words) also included black vowels with black keyword-pictures over them to translate the irregular vowels. These were for the Black/A-V Group, since it's impossible to do A-V spelling with nonphonetic

words unless the vowels are translated through colors, pictures, or some form of diacritical notation.

The words were also presented in one piece through word-matching games, with the words on five-by-eight cards, two cards for each word and four words for each of the six word-sets, plus the three packs of untaught words (packs A', C', and E'), with four words in each pack. The word-cards, which were used for both word-matching games and for posttesting, had colored vowels for the color groups and black vowels for the black groups and for posttesting the color groups in black. There were no corresponding letter-packs for the untaught words.

Word-packs A, C, and E had colors on the back so that matching words that also had matching colors on the back would "win." (For these, four words were laid on the table, and the other four were matched to them before turning them over to see if the colors matched.) Word-packs B, D, and F did not have colors on the back. (For these, the words were arranged in two piles and removed one at a time to see if the same word would appear on both piles.) For all the word-matching games, the purpose of the game was to match words, but the children were also asked to read the words.

After the last (fifteenth) lesson, each child was given or sent a booklet as a measure of appreciation for participating in the experiment. The booklets had the embedded-consonant pictures

on one page and embedded-vowel pictures (in color) on another. The third page listed the keywords and mentioned mnemonic tricks like "The u is the handle of the umbrella."

RESULTS

A preliminary F test was carried out for the color, black, A-V, and non/A-V conditions, with two groups of six children in each category because of the two-by-two factorial design (Figure 1). An obtained F of 5.395 for color over black when Groups 1 and 2 were reading in color was significant at the .05 level of confidence (critical F: 4.35), but obtained F's of .011 for the A-V condition and .013 for interaction effects were not significant.

		Word Technique	
		A-V	Non/A-V
Letter Technique	Colored Vowels	Group 1 (6 children)	Group 2 (6 children)
	Black Vowels	Group 3 (6 children)	Group 4 (6 children)

Figure 1: Division of Groups

An analysis of variance with t tests was conducted on mean scores for the four conditions. As can be seen in Table III, the color groups made significantly fewer errors in their total word scores than the black groups. The difference was greater when the

TABLE III

WORD-RECOGNITION ERRORS MADE BY COLOR-CODE AND NON-COLOR GROUPS

Colored-Vowel and Transfer Scores For Color Groups

	Mean	Standard Deviation	Variance	t Test
Groups 1 and 2 (color) Reading in color	2.67	1.87	3.52	8.98*
Groups 3 and 4 (black)	6.33	4.87	23.70	

	Mean	Standard Deviation	Variance	t Test
Groups 1 and 2 (color) Transfer to black	5.08	1.56	2.45	3.06*
Groups 3 and 4 (black)	6.33	4.87	23.70	

significant at .01 level

color groups were reading in color, but it was also significant at the .01 level of confidence when the color groups transferred to black.

Both color and black groups made more errors when reading words not previously taught, as can be seen in Table IV, but the difference between the color and black groups was again significant at the .01 level of confidence. (The color groups were not tested in black on the untaught words.) There were only twelve untaught

TABLE IV
WORD-RECOGNITION ERRORS MADE BY COLOR-CODE AND NON-COLOR GROUPS READING WORDS NOT PREVIOUSLY TAUGHT
Color-Code Groups Reading Words With Colored Vowels

	Mean	Standard Deviation	Variance	t Test
Groups 1 and 2 (color) Untaught words (12 words)	5.58	3.45	11.9	7.35*
Groups 3 and 4 (black) Untaught words (12 words)	8.58	2.39	5.72	

* significant at .01 level

words, compared with twenty-four words previously taught, so the mean error scores for the untaught words represent higher percentages of error than the scores in Table III. Thus, of the 288 untaught words (twelve words presented to twenty-four

children, with the color groups reading in color), 59% were read incorrectly, while of the 576 words that were taught (twenty-four words taught for two lessons to twenty-four children, with the color groups reading in color), only 18.75% were read incorrectly.

The difference between the A-V and non/A-V groups when Groups 1 and 2 were reading in color was minimal (Table V). After Groups 1 and 2 transferred to black, however, the difference between the

TABLE V
WORD-RECOGNITION ERRORS MADE BY A-V AND NON/A-V GROUPS
Colored-Vowel and Transfer Scores for Color Groups

	Mean	Standard Deviation	Variance	t Test
Groups 1 and 3 (A-V) Group 1 in color	4.42	3.53	12.45	.41
Groups 2 and 4 (non/A-V) Group 2 in color	4.58	4.70	22.08	
Groups 1 and 3 (A-V) Group 1 in black	5.33	2.96	8.79	1.84*
Groups 2 and 4 (non/A-V) Group 2 in black	6.08	4.23	17.90	

*significant at the .05 level

A-V and non/A-V groups was significant at the .05 level (not the .01 level as in the comparison between color and black).

As can be seen in Tables VI and VII, dividing the words into phonetic categories revealed significant differences at the .01

TABLE VI
WORD-RECOGNITION ERRORS MADE BY COLOR-CODE AND NON-COLOR GROUPS
Color-Code Groups Reading Words With Colored Vowels

	Mean	Standard Deviation	Variance	t Test
Groups 1 and 2 (color) All words (24 words)	2.67	1.87	3.52	8.98*
Groups 3 and 4 (black) All words (24 words)	6.33	4.87	23.70	
Groups 1 and 2 (color) Short-vowel words (8 words)	.58	.67	.45	.41
Groups 3 and 4 (black) Short-vowel words (8 words)	.42	.67	.45	
Groups 1 and 2 (color) Vowel-combination words (8 words)	1.00	1.04	1.09	2.65*
Groups 3 and 4 (black) Vowel-combination words (8 words)	2.08	2.07	4.27	
Groups 1 and 2 (color) Nonphonetic words (8 words)	1.08	1.16	1.36	6.74*
Groups 3 and 4 (black) Nonphonetic words (8 words)	3.83	2.76	7.61	

* significant at .01 level

TABLE VII
WORD-RECOGNITION ERRORS MADE BY COLOR-CODE AND NON-COLOR GROUPS
Color-Code Groups Transferring to Words With Black Vowels

	Mean	Standard Deviation	Variance	t Test
Groups 1 and 2 (color) All words (24 words)	5.08	1.56	2.45	3.06*
Groups 3 and 4 (black) All words (24 words)	6.33	4.87	23.7	
Groups 1 and 2 (color) Short-vowel words (8 words)	.50	.80	.64	.20
Groups 3 and 4 (black) Short-vowel words (8 words)	.42	.67	.45	
Groups 1 and 2 (color) Vowel-combination words (8 words)	1.83	1.27	1.61	.61
Groups 3 and 4 (black) Vowel-combination words (8 words)	2.08	2.07	4.27	
Groups 1 and 2 (color) Nonphonetic words (8 words)	2.75	1.54	2.39	2.65*
Groups 3 and 4 (black) Nonphonetic words (8 words)	3.83	2.76	7.61	

* significant at .01 level

level between the color and black groups in reading vowel-combination words (with Groups 1 and 2 reading in color but not in black) and nonphonetic words (with Groups 1 and 2 reading in both color and black) but only slight differences in reading short-vowel words in both color and black. In fact, the color groups, when reading the eight short-vowel words, made slightly more errors than the black groups, with a mean of .58 in color and .50 in the transfer to black, in contrast to a mean of .42 for the black groups.

The greatest difference between the color and black groups occurred in reading the eight nonphonetic words, with mean error scores of 1.08 in color and 2.75 in black for the color groups, compared to 3.83 for the black groups, both significant differences. Results for the eight vowel-combination words, however, were mixed. The color groups did significantly better than the black groups in color, with a mean error score of 1.00, compared to 2.08 for the black groups, but during transfer their errors climbed to a mean of 1.83, almost as high as the black mean of 2.08. Though mean transfer scores for the color groups climbed higher still for the nonphonetic words (2.75 errors), the color scores were no longer similar to the scores of the black groups, who made significantly more errors in nonphonetic words (3.83 errors). Thus the color and black groups made similar scores with vowel-combination words when the color groups transferred to black, but the color groups did significantly

better in color with both types of words and significantly better with nonphonetic words in both color and black.

As for the differences between vowel-combination and nonphonetic words, the color groups, when reading in color, earned nonphonetic scores that were similar to their vowel-combination scores, with mean error-scores of 1.00 for vowel-combination words and 1.08 for nonphonetic words. There was a fall-off, however, during the transfer from color to black, after which the vowel-combination and the nonphonetic scores were no longer comparable. Thus their mean error-score in black (their transfer score) was smaller for vowel-combination words (1.83 errors) than for nonphonetic words (2.75 errors) even though their scores were almost identical in color (1.00 and 1.08 errors). The black groups made still more errors, with mean scores of 2.08 for vowel-combination words and 3.83 for nonphonetic words, and the error score for nonphonetic words (like the transfer score of the color groups) was higher than for vowel-combination words. As a result, a significant difference occurred between the groups with nonphonetic words but not with vowel-combination words when one compares the transfer scores of the color groups with the scores of the black groups. Yet, in color, the scores for the two types of words were almost identical.

To sum up, when comparing color and black, the color and black scores were similar for reading short-vowel words but were significantly different in favor of color for reading vowel-combination and, especially, for reading nonphonetic words. Also, transfer scores were significantly different in favor of the color groups for reading black nonphonetic words but not black vowel-combination words. Although the scores for vowel-combination words and nonphonetic words were almost identical for reading in color, the difference between the color and black groups was greater with nonphonetic words than with vowel-combination words, and this distinction applies to transfer scores as well as color scores.

When the words were again broken down into phonetic categories, this time for the A-V and non/A-V groups, a difference between the two conditions occurred in the vowel-combination words but not in the other two types (Tables VIII and IX). The difference between the A-V and non/A-V groups was not significant when Groups 1 and 2 read the vowel-combination words in color (with means of 1.25 errors for the A-V groups and 1.83 errors for the non/A-V groups) but was significant at the .05 level when Groups 1 and 2 transferred to black (with means of 1.58 errors for the A-V groups and 2.33 errors for the non/A-V groups). In contrast, the relatively lower error-scores for short-vowel words and relatively higher error-scores for nonphonetic words were similar for both the A-V and non/A-V groups in both color and black. In fact, the

TABLE VIII
WORD-RECOGNITION ERRORS MADE BY A-V AND NON/A-V GROUPS
Groups 1 and 2 Reading Words With Colored Vowels

	Mean	Standard Deviation	Variance	t Test
Groups 1 and 3 (A-V) All words (24 words)	4.42	3.53	12.45	.41
Groups 2 and 4 (non/A-V) All words (24 words)	4.58	4.70	22.08	
Groups 1 and 3 (A-V) Short-vowel words (8 words)	.58	.67	.45	.41
Groups 2 and 4 (non/A-V) Short-vowel words (8 words)	.42	.67	.45	
Groups 1 and 3 (A-V) Vowel-combination words (8 words)	1.25	1.29	1.66	1.43
Groups 2 and 4 (non/A-V) Vowel-combination words (8 words)	1.83	2.04	4.15	
Groups 1 and 3 (A-V) Nonphonetic words (8 words)	2.58	2.50	6.27	.61
Groups 2 and 4 (non/A-V) Nonphonetic words (8 words)	2.33	6.79	2.61	

TABLE IX
WORD-RECOGNITION ERRORS MADE BY A-V AND NON/A-V GROUPS
Groups 1 and 2 Transferring to Words With Black Vowels

	Mean	Standard Deviation	Variance	t Test
Groups 1 and 3 (A-V) All words (24 words)	5.33	2.96	8.79	1.84*
Groups 2 and 4 (non/A-V) All words (24 words)	6.08	4.23	17.90	
Groups 1 and 3 (A-V) Short-vowel words (8 words)	.58	.79	.63	.61
Groups 2 and 4 (non/A-V) Short-vowel words (8 words)	.33	.65	.42	
Groups 1 and 3 (A-V) Vowel-combination words (8 words)	1.58	1.31	1.72	1.84*
Groups 2 and 4 (non/A-V) Vowel-combination words (8 words)	2.33	1.97	3.88	
Groups 1 and 3 (A-V) Nonphonetic words (8 words)	3.17	2.08	4.33	.61
Groups 2 and 4 (non/A-V) Nonphonetic words (8 words)	3.42	2.50	6.27	

* significant at .05 level

A-V groups made a few more errors than the non/A-V groups in nonphonetic words when the color groups were reading in color and in short-vowel words when the color groups were reading in both color and black.

To test the other aspect of A-V spelling, that of errorless learning during first encounters, a comparison was made between the first-encounter spelling of the children in the two A-V groups and their reading of both taught and untaught words, with Group 1 using colored vowels. These two comparisons produced opposite results. As can be seen in Table X, the children in Groups 1 and 3 (the A-V groups) made significantly fewer errors when reading the twenty-four words after two practice sessions (with three encounters per session) than when spelling them with letter cards

TABLE X
A-V SPELLING ERRORS ON NEWLY INTRODUCED WORDS
AND WORD-RECOGNITION ERRORS ON THE SAME WORDS
AFTER TWO PRACTICE SESSIONS
Group 1 Using Colored Vowels

	Mean	Standard Deviation	Variance	t Test
A-V Spelling Groups 1 and 3 (24 words)	6.00	3.07	9.45	3.88*
Reading Groups 1 and 3 (24 words)	4.42	3.53	12.45	

* significant at .01 level

(A-V spelling) without previous instruction. Out of 288 words (twelve children spelling twenty-four words each), there were seventy-two errors. Of these errors, none were in initial consonants, two were in final consonants, and the other seventy were in vowels.

In comparing A-V spelling with reading the untaught words (both are first-encounter conditions), percentages rather than raw error scores were used because there were only twelve untaught words, while the regular twenty-four words were used for A-V spelling (Table XI). In this comparison, the A-V groups made

TABLE XI
A-V SPELLING ERRORS ON NEWLY INTRODUCED WORDS
AND WORD-RECOGNITION ERRORS ON UNTAUGHT WORDS
Group 1 Using Colored Vowels

	Mean	Standard Deviation	Variance	t Test
A-V Spelling Groups 1 and 3 Taught words (24 words)	24.99%	12.81	164.18	3.46*
Reading Groups 1 and 3 Untaught words (12 words)	58.33%	30.77	947.08	

* significant at .01 level

significantly lower percentages of error in A-V spelling than they did in reading the untaught words. As mentioned above, all but two of the spelling errors involved vowels.

Although it was not part of the experimental procedure, an attempt was made to explore the relationship between blending and letter scores and the final word scores. Table XII lists correlations between word scores and letter scores and also between word scores and blending scores, which were based on the number

TABLE XII
CORRELATIONS OF LETTER AND BLENDING SCORES TO FINAL WORD SCORES

	Letter Scores	Blending Scores
All 24 children Groups 1 and 2 in color	.33	.54
All 24 children Groups 1 and 2 in black	.18	.68
Group 1 (color/A-V) Reading in color	.56	.56
Group 1 (color/A-V) Reading in black	.59	.02
Group 2 (color/no A-V) Reading in color	.47	-.60
Group 2 (color/no A-V) Reading in black	.43	.79
Group 3 (black/A-V)	.22	.86
Group 4 (black/no A-V)	.56	.88

of errors out of ten attempted words. The correlations with letter-scores were low and negligible for the group as a whole (.33 and .18) but were moderate for all but Group 3 when correlations were made for each cell of six children. Group 3's correlation was low (.22). Since children with more than three letter-errors were not included in the experiment unless they had no "poor" scores in the screening index, these correlations apply only to a pre-screened population.

The children were not pre-screened according to blending scores, though they were counterbalanced, and the correlations between blending and word scores varied more than the correlations between letter and word scores. While the correlation was high for each of the black groups (.86 and .88), it was lower for the color/A-V group, especially during transfer (.56 in color and .02 in the transfer to black). The color/no A-V group had a negative correlation of -.60 in color, which changed to a positive correlation of .79 when transferring to black, a correlation that was almost comparable to the correlations for the black groups. This fluctuation was partly due to the fact that the number of errors for this group more than doubled during the transfer to black and increased the most for two children whose blending scores were 30% and 40% (three and four words correctly blended out of ten) and whose error scores went from one error each in color to six and nine errors in black.

DISCUSSION

Because of the two-by-two factorial design, two separate studies were carried on simultaneously in this experiment, one on color-coding vowels and the other on using spelling with cues (A-V spelling). What both approaches have in common is the attempt to achieve "errorless" learning or at least to minimize errors during the first stages of learning. Two questions inevitably accompany the issue of errorless learning; one is whether the transfer to uncued reading (without color cues and without visual spelling cues) is facilitated or impeded by having these cues available during acquisition; the other is whether the eventual results of cued, errorless learning justify the time and expense of preparing special materials. From the results of this study, the first question can be tentatively answered in favor of the additional cues, but the second question doesn't lend itself to experimental procedure as much as it does to one's personal assessment as to which pupils need how much extra assistance.

Color-Coding

In the comparisons between color-coded and black-print reading, the results are consistent with those of Lyczak (1976), in that teaching color-coded words, accompanied by transfer training in black letters, seemed to facilitate acquisition and did not impede transfer to all-black words. Unlike Lyczak's results, however, the

transfer scores of the color groups were also significantly better than the all-black scores, though the difference was not as great as when the color groups were reading in color. The effect of transfer training as such was not measured as it was in the Lyczak experiment, since all four groups were trained in both colored and black vowels, but it seems likely from his results that transfer scores in this study would have been different if the color groups had been trained in color alone without training in black vowels.

The color groups also did significantly better than the black groups in reading untaught words, suggesting that self-reliance in figuring out unknown words is probably fostered by devices, like color-coding, that make the vowels translatable. On the other hand, the much higher error percentages (59% for the untaught words compared with 18.75% for words encountered six times in two lessons) supports the practice of controlling new words and of teaching new words and not just teaching their phonetic components and expecting young beginners to apply these sounds without assistance.

As for the "taught" words, whether more than six encounters would have reduced error scores for all four groups was not studied. All twenty-four children were reciting the black vowels without error within two lessons of letter-score tests that had yielded a range of error scores two lessons earlier, so it's possible that further practice with the words would have produced similar improvements in word recognition.

The three types of words-- short vowel, vowel-combination, and nonphonetic-- created a heirarchy of difficulty: the short-vowel words produced low error scores, while errors increased for the vowel-combination words and increased further for the nonphonetic words. The harder the words, the more color seemed to make a difference between the color and the black groups. With the short-vowel words, the difference was minimal, and the black groups actually made somewhat fewer errors than the color groups. On the other hand, the difference in favor of color was significant for vowel-combination words and was greater still for nonphonetic words, for which the transfer scores were also significantly better than the all-black scores. The error scores of the color groups were also lower in color than in the transfer to black for both types of words, suggesting that the color groups were relying on the colors before transfer at least part of the time.

These results point to the possibility that color seems least useful when dealing with three-letter, short-vowel words and most useful when dealing with hard-to-translate, irregular spellings. Thus, if one were to color-code words selectively, first priority would probably go to nonphonetic words, while short-vowel words could probably be left uncolored. It should be noted, though, that these short-vowel words were three-letter words. Whether color would be helpful with short-vowel/consonant blend words, which are harder to sequence, was not tested. Similarly, the long vowels and

their color were not included in the experiment, so the use of color to distinguish short from long vowels was also not tested.

It is apparently easier not to have to chunk more than one element into a single sound, since the lowest error scores went to colored and black short-vowel words, with one vowel letter to a sound, and the next lowest scores went to colored vowel-combination and nonphonetic words, with one color though not one letter for each sound.

One exception to the heirarchy of difficulty is the fact that the color groups, when reading in color, made virtually identical scores in vowel-combination and nonphonetic words even though the nonphonetic words caused more problems during transfer. Thus it seemed to make little difference whether a word was phonetic or not as long as it was printed in color. Either way, it was apparently equally translatable (or untranslatable). The difference between vowel-combination and nonphonetic words surfaced when reading in black, however, since error scores for black words were higher for nonphonetic words than for vowel-combination words. Thus, for beginning readers in non-color-code programs, it would make sense to introduce nonphonetic words gradually, but it might be possible in a color program to introduce them at the same rate as vowel-combination words, thereby achieving a more natural story-telling vocabulary.

Scores diverged significantly in favor of color when the color groups read vowel-combination words in color and read nonphonetic words in both color and black. One exception to this pattern is that there was little difference between the color and black groups when reading the vowel-combination words in black even though the color groups did significantly better with these words in color. Since all four groups had lower error scores in vowel-combination words than in nonphonetic words when reading in black, it's possible that children in all four groups were making at least some use of the vowel spellings that they practiced in black at the beginning of each lesson. Therefore, it would seem that training in the black vowels may have helped both color and black groups.

Though the color groups apparently relied more heavily on the colors when reading in color and consequently made more errors during transfer than they had made in color, they nevertheless made somewhat fewer errors in black than the black groups in the vowel-combination words and significantly fewer errors in black in the nonphonetic words. Thus it would seem that relying on the colors does not necessarily rule out using the vowel spellings in black when the colors are not available in vowel-combination words, provided that these vowel spellings are taught in addition to the

colors, and there may have been some spontaneous "fading" as they relinquished their dependence on the colors in those words that they read correctly in black.

Since training in black vowel-combinations seemed to improve transfer, the question remains whether it is better to transfer new words immediately to black on a rolling basis or whether transfer would be easier if delayed until a stage when it occurs more spontaneously. The children in this pre-screened group appeared ready to transfer to black vowel-combination words, but the short-vowel words were apparently too easy to require color-coding, while error scores in the nonphonetic words were so much higher in black than in color that a delay might have been preferable (or at least more than six encounters with each word). A less ready group, on the other hand, might have found the vowel-combination words too hard, while a more advanced group might have been more ready for the nonphonetic words in black. It would seem, then, that transfer should be flexible and would tend to vary from group to group.

If transfer is delayed, these results do not support the idea that dependence on the colors inhibits transfer to black, although practicing the vowels regularly in black may be essential. The problem of delayed transfer is instead the necessity for color-coding materials, a time-consuming task that is probably only feasible for remedial work. For slow readers, though, the time

spent in color-coding non-consumable materials could result in wider reading during the period when letter-sound associations and word-recognition are too unstable for efficient reading in black.

The alternatives between waiting and proceeding with a code system before readiness for transfer are similar to those considered in the i.t.a. debate, except that the unlearning of changed spellings is not involved. With average readers, the time of readiness is a less crucial issue, but with learning-disabled children, the time factor is critical because of the need to preserve morale, so that approaches which speed word-recognition should be tested from the standpoint of success in the pre-transfer stage as well as after transfer. This issue is relevant today because starting reading instruction in Kindergarten is becoming more widespread and because learning-disabled children are no longer expected to drop out of school semi-literate.

Timing is also involved when one must decide how long to spend with letters and how long with words when teaching children of different ages. The children in this study seemed to find letters easier than words and made errors in word recognition at a time when they were identifying individual letters without error. This discrepancy may be due to the fact that there were twenty-four words but only thirteen vowels to memorize and also to the fact that each word was encountered only six times. Marchbanks and

Levin (1965) and Chall (1983), however, reported that children this age tend to recognize words by individual letters rather than by configuration. These children, too, seemed to have a letter-by-letter approach to their first encounters with words and seemed unready to make the leap from letters to words before several exposures. If so, then overlearning letter-sound associations, as Bannatyne (1974) stressed, may be needed as much as additional practice with those words that are not memorized quickly.

Practicing letters, however, should apparently not take the place of practicing words, since error-percentages were more than three times higher for the untaught words than they were for those words that were practiced for two lessons with three encounters per lesson. Thus it seems unrealistic to expect young beginners to apply the phonics they have learned to unfamiliar words even when they have regularly (and accurately) practiced their letters and sounds as the children did in this experiment.

One question that arose while this study was in progress is whether the blending ability of young beginners is affected or compensated for by color-coding. The assumption that blending is an essential component of word technique was supported by the correlations between blending and word scores in this experiment, at least for reading in black. For three of the groups, correlations were high (.79, .86, and .88) between blending scores and reading scores for black words, although the Color/A-V group had a

correlation of .02. This minimal correlation may be partly due to the fact that the number and therefore the range of errors was smaller for this group than for the other groups, so that minor variations in word scores affected the correlation more than the same variations would have done in groups with higher and more widely varied error scores. For the color groups, when they were reading in color, there seemed to be little relationship, with a positive correlation of .56 for the color/A-V group and a negative correlation of -.60 for the color/no A-V group.

Thus one could tentatively say that good blending is more necessary for reading in black but that an additional cue like color seems to help a child compensate for insecure blending. These correlations are tentative, since counterbalancing for blending was approximate but not perfect, but it might be fruitful to explore the shift in correlations between color and black with a group that is both larger and more precisely counterbalanced for blending scores.

If color does indeed compensate somewhat for poor blending, one is reminded of the observations of LaBerge and Samuels (1974) on the need for automaticity in reading. Before children can arrive at this automaticity in blending, sequencing, and letter-sound associations, it would seem that any cue, whether it be color or context or a modified alphabet, will bridge the gap between less-than automatic skills and the isolated, uncoded, out-of-context

word. If so, a case could be made for practicing blending through the reading of color-coded words and for delaying transfer until blending is more secure.

Before automaticity is achieved, cues which speed word-recognition can foster both fluency and comprehension. While color is one of the possible cues, context is probably one of the most powerful. It's possible, though, that some beginning-reading programs over-rely on context (or a combination of initial consonant and context) to compensate for weak word attack and word recognition. Advanced readers can often figure out both meaning and pronunciation when an unfamiliar word is surrounded by familiar ones, but a beginning reader can be confronted by an unfamiliar word surrounded by other unfamiliar words that are of little help to him. If he has only a beginning consonant to supplement his uncertain grasp of the context, his arsenal is limited. Thus, for beginning readers, it's possible that use of context should be supplemented by such supports as well memorized vowels as much as phonic cues should be supplemented by assistance from the context. If vowels can be made easier through the use of color cues, then the likelihood should be increased that phonics and context can work together to foster fluency.

A question that was not answered in this experiment was whether it is better to color-code only the vowels or to color consonants as well, as is done in the Gattegno code. The children in this study memorized (or reviewed) the fourteen consonants in the twenty-four words to a criterion of 100% within six lessons even though their reading and spelling errors were almost entirely vowel errors (b and d were not included). This accuracy with the consonants supports Liberman's findings that children have little trouble learning the spelling-to-sound correspondences of the consonants, in contrast to the extra difficulty of learning vowels (Liberman, 1973). Thus, although there was no control group using the Gattegno code, it would seem that consonants are too easy to need color coding (picture cues can be used for b and d), while the advantages of highlighting vowels in contrast to black consonants and of limiting the number of colors to be memorized would suggest that a vowels-only code like the Bannatyne code or the one used in this study would be preferable to an all-letters code.

Another aspect of color-coding that was not tested in this experiment was whether using colors as cues to sounds without the use of keywords (as in the Gattegno code) is more or less effective than using colored keyword pictures to provide mnemonic links between the color-cues and the sounds they represent. While using the colored keyword pictures in this study did not prevent the

color groups from outperforming the black groups, there was no control group using colors without keywords or a single color for highlighting to compare with colors used mnemonically. Unless these comparisons can be made, those studies designed to evaluate color in learning and especially the evaluations of the Gattegno program provide a limited assessment of the role of color in beginning reading.

Spelling With Visual Cues (A-V Spelling)

In the comparison between the A-V and non/A-V groups, differences were minimal when the color groups were reading in color. When the color groups transferred to black, however, the color groups made significantly fewer errors in both their total-word scores and their vowel-combination scores, although the significance was at the .05 level, not the .01 level as it was in the comparison between color and black. Similar to the comparisons between color and black, error scores were lowest for short-vowel words and highest for nonphonetic words. Differences between the A-V and non/A-V groups were slight in both color and black for short-vowel words and nonphonetic words, possibly because the short-vowel words were too easy and the nonphonetic words were too hard for A-V patterning to be of any assistance.

If the vowel-combination words in black constituted the instructional level, the optimum challenge, for this particular group of children, then help with patterning the letter-sounds

may have contributed to the lower error scores of the A-V groups in vowel-combination words. It would be necessary, though, to try a larger number of words with a larger number of children to see if this difference would repeat itself. It could also be fruitful to include the hard-to-sequence short-vowel/consonant-blend words (with slightly older children, perhaps, because of their difficulty) in a test of learning by the A-V route. Both types of words require the chunking of letters (vowels in vowel-combination words and consonants in "blend" words), and with this chunking come sequencing problems that would be a good test of a patterning device like A-V spelling. What should also be tested is whether written spelling with A-V clues on the board or on paper rather than on separate cards is useful in teaching reading and spelling to somewhat older children, especially those with remedial problems.

The other aspect of A-V spelling, that of errorless learning, was also investigated in this study, by comparing the first-encounter spelling scores of the children in the two A-V groups with their error scores for reading both taught and untaught words (with Group 1 using colored vowels). For the A-V spelling scores, a spelling word was counted as wrong if the teacher had to supply a cue (pronouncing the vowel sound in isolation or supplying the keyword). The same spelling scores were compared with both the total-word scores for "taught" words and the separate scores for "untaught" words.

Results were significant in two directions. In a comparison of their first-encounter spelling of the twenty-four words (spelled without previous instruction) with their reading of the same words after two practice lessons (with three encounters per lesson), the A-V children made significantly more A-V spelling errors than reading errors. Therefore, there appears to be no substitute for instruction when introducing new words to beginners.

On the other hand, in a comparison of the same spelling scores with the reading scores for the twelve untaught words (read without previous instruction), the A-V children made significantly fewer spelling errors than reading errors. This comparison was between two first-encounter conditions, so there was no previous instruction to tip the scales in favor of reading. In this case, with error percentages of 25% and 58%, spelling with cues was apparently considerably easier than reading, possibly because the necessary letters were simultaneously visible at the recognition level, whereas the correct letter-sounds for reading had to be retrieved, at the total-recall level, before they could be blended into words.

There was no way to determine whether blending the sounds (reading) was more or less difficult for the A-V children than peeling or segmenting the sounds (spelling) because they all carried out both operations without error during their first lessons with new words. Thus, if a child made a spelling error,

the error was in choosing the wrong letter-card; no child was "stuck" because he couldn't peel off the sounds or arrange them on the beginning-middle-end card. (There was some directional confusion during the introductory lesson, but the teacher sat on the children's left, directing them to "start on my side," so errors that might have occurred with no teacher at a child's elbow were forestalled.)

Similarly, all the A-V children, even those with low blending scores, performed the "read-back" correctly after doing A-V spelling, reading without error those words that they had just "spelled," even if they were later unable to read some of the same words after a time lapse during the final posttest one or two lessons later. In contrast, some of the non/A-V children needed help with blending during their first encounters with new words but read them without error the second time, though they, too, lost some of the words during the final posttest. The ability to segment the sounds might have been less well developed in children who were less ready than these pre-screened children, but most of them were younger than the typical first-grader.

Being successful when doing A-V spelling followed by a "read-back" does not guarantee successful transfer to the same words without clues after a time lapse as one can see from the error scores of the two A-V groups, but it is apparently a face-saving way to practice not-yet-memorized words, From the standpoint

of errorless learning, it is obviously no substitute for total-recall reading and spelling, but the results show that transfer was not impeded by A-V spelling and, for vowel-combination words, it may even have been somewhat facilitated.

From a break-down of the A-V spelling scores, it is possible to see how A-V spelling can be made more "errorless" than it was in this study: Out of 288 words (twelve children spelling twenty-four words each), no errors were in initial consonants, two were in final consonants, and seventy were in vowels. Also, all the children were able to correct their spelling errors if the teacher named the keyword for the correct vowel, thereby helping them with the auditory-discrimination task and leaving only the letter-sound-association task, which could be performed at the recognition rather than the retrieval level. Thus measurement of the children's ability to map or pattern the letters in their words was contaminated by the auditory-discrimination task. From the standpoint of errorless learning, then, it would seem to be possible to arrange for errorless spelling by using word-sets that contain only one vowel each, thus eliminating what was the major source of errors in these spelling scores.

Although no tape recorder was used to measure the number of spoken words used, there was considerably less verbiage on the part of the teacher when presenting words to the A-V groups. A word was pronounced whole, included in a sentence, then pronounced

a second time. If a child had trouble with a vowel, the teacher pronounced the vowel sound in isolation (then scored the word as wrong) or named the keyword if the isolated sound was not enough.

In teaching words synthetically, however, it was necessary to say things like "What's this sound?", "What's this next sound?", and "Now put them together," and it was also necessary to repeat the sounds and sometimes to blend them for a child if he could not do it alone. Thus a comparative measure of spoken words would have provided an assessment of the amount of interference on the part of the teacher required for the two approaches. Additional interference occurred when the teacher manipulated the letter-cards for the non/A-V groups in comparison to the way the A-V children could handle the cards themselves as they constructed their own words. Consequently, it's possible that self-reliance could be fostered by this approach as well as the confidence engendered by errorless spelling and "read-backs."

CONCLUSIONS

Within the limitations of this study, these conclusions about color-coding, reading without color, and spelling with visual cues seem to be warranted:

Color-coding, at least when used with colored keyword pictures:
1 - makes all but short-vowel words easier for beginning readers.
2 - fosters self-reliance with new words.

3 - does not hinder transfer to black provided that the children are trained in black as well as colored vowels.

4 - chunks multiple-vowel spellings and makes vowel-combination words only a little harder than three-letter, short-vowel words.

5 - renders nonphonetic words translatable and as decodable as vowel-combination words, although nonphonetic words are harder to transfer to black than other types of words.

6 - makes more of a difference with nonphonetic words than with other types of words, not only in color but also after the transfer to black (since the children who learned the nonphonetic words in black made significantly more errors than the children who had learned them in color, then transferred to black).

7 - may help poor blenders improve their blending, at least when they are at the same stage of readiness as the non-reading Kindergarten and first-grade children in this study.

On reading without colors:

1 - Handling the transfer to black with flexibility may be preferable to an abrupt withdrawal of color, since some words are easier to transfer than others.

2 - Training in black vowel-combinations probably facilitates the reading of vowel-combination words in black whether or not

they are read first in color.

3 - Three-letter, short-vowel words produce the lowest error scores in both color and black, at least when only a few are introduced at a time, so it makes sense to start reading instruction with these "trigram" words. (Not tested were the short-vowel/consonant blend words, which might produce different results, or the effect of allowing the number of trigram words to expand as rapidly as it does in some beginning programs.)

4 - There seems to be no substitute for instruction when introducing new words to beginners. Therefore, reading programs in which children are taught the letter-sounds (or learn them inductively) but are expected to apply these sounds without help to rapidly increasing vocabulary loads might produce better results and fewer errors during the first stages of learning with controlled vocabularies and more provision for practicing new words.

On spelling with visual cues (A-V spelling):

1 - First-encounter spelling with visual cues is easier than first-encounter reading and can be made virtually error-free when there is only one vowel to a word-set.

2 - Vowel-combination words are easier to read in color, but spelling with visual cues facilitates the transfer to black.

3 - The "read-back," after spelling a word-set of four words with visual cues, is usually successful, probably because the letter-sounds and the pattern of letters are still in the short-term memory. Thus, spelling with cues can be a way to read without error (and thereby save face) while practicing words that are not yet mastered.

4 - Since a successful "read-back" does not guarantee error-free reading after a time lapse, the same words need to be practiced further, or at least retested later, but spelling with cues serves as an "errorless" introductory procedure.

5 - When introducing words by the spelling-with-cues procedure, less verbalizing on the part of the teacher is needed than for conventional, synthetic decoding.

6 - Being able to manipulate the cards themselves with few directions from the teacher may foster self-reliance in children who are not yet able to decode words without help.

IMPLICATIONS FOR TEACHING AND RESEARCH

The use of modified alphabets and errorless-learning techniques is probably unnecessary for many children. For others, though, especially those who are too immature or too disabled to accomplish the earliest stages of reading and spelling with ease, error-minimizing methods can provide a way to save face while learning what can't be mastered quickly and a way to preserve morale at a time when failure can cause resistance to further

instruction. Which children need which techniques and to what extent may require trial-and-error on the part of the teacher. It's doubtful, though, that all children are weathering their introduction to reading and spelling so smoothly that further studies of various learning approaches are no longer needed.

There are three types of children in particular for whom a case could be made for errorless learning. One is the child who is habitually inaccurate, who perseverates in making errors if these errors are not prevented before they start. Another is the child who is easily discouraged, who needs success in his first encounters with new learnings to give him the momentum to progress further. A third is the child who is too learning-disabled to remember his words from one lesson to the next and needs many repetitions and plenty of written spelling before they are memorized. For children like this, the need for confidence, enthusiasm, and habits of accuracy may warrant the time spent on preparing special materials.

Books

When considering ways to make reading easier for beginners, an important question is what kinds of books are best for the earliest stages of reading. Is it better to follow the vocabulary sequence of the typical basal reader, with a natural story-telling vocabulary (containing a large number of nonphonetic words) or is it better to follow the vocabulary sequence of the typical phonetic-

linguistic reader, with a rapidly multiplying vocabulary of short-vowel words? It's possible that neither type is ideal.

The low error-scores for three-letter, short-vowel words supports the practice of starting reading with these "trigram" words as is done in phonetic programs. The vocabulary in these programs tends to expand rapidly, however, so that the children must decode a large number of unfamiliar, look-alike words and follow a story at the same time, while the artificial, short-vowel vocabulary makes it hard to use the context for fluency. The introduction of letters is usually controlled more in phonetic-linguistic programs than the introduction of words (the two forms of control actually don't need to be mutually exclusive), but the higher error scores for untaught words in this study support the practice of controlling vocabulary as well as letters. Thus, though practicing short-vowel words through workbooks and flashcards is probably a good way to develop decoding skills, trying to follow a story and decode a rapidly expanding vocabulary at the same time may be difficult for all but the more facile decoders during the first stage of learning to read. According to Chall (1983), combining comprehension with an expanding vocabulary may be more appropriate for the second stage of reading, which may not occur for some children until the middle of second grade.

An additional problem with phonetic programs is the early introduction of short-vowel, consonant-blend words. "Blend" words

were not studied in this experiment, so statistical comparisons are needed to determine whether they are easier or harder than other types of words (especially if these words are color-coded), but there is a possibility (which should be tested) that there is a maturity factor in reading blend words and that introducing them prematurely makes them more troublesome than they are for somewhat older children.

The results of this study suggest that vowel-combination and nonphonetic words (if they are color-coded) are only a little harder than three-letter, short-vowel words, Thus it's possible that the more varied and natural vocabulary of trade books, basal readers, and experience stories, if the words are learned through color-coding, is easier than the "blend-word" stage in phonetic programs. The fact that the vocabulary in basal programs is controlled, that the words are less similar visually, and that the natural vocabulary encourages the use of context clues would presumably foster fluency in the earliest stage of reading more than stories filled with short-vowel/consonant-blend words.

Color-Coding

If color-coding is used with basal readers, few special materials are needed for those children who can transfer to black before starting a story. The varied transfer scores in this study, though, seem to indicate a need for flexibility in handling transfer rather than an abrupt withdrawal of color. Flip-over cards with

words in color on one side and black on the other can provide this flexibility, since the words can be practiced in both color and black and can be transferred to black on a rolling basis. Colors can be crayoned over the black vowels on flashcards, while the cards lend themselves to games that can be played with both individuals and groups. This way provision can be made for the fact that some children transfer more easily than others and some words are easier to transfer than others.

The principal problem with color-coding is what to do about children who have difficulty with transfer and can't manage stories in black and white. There seem to be three alternatives: using books with a code system or a modified alphabet, using phonetic books until the blend-words and the vocabulary load become too hard, or delaying books until black-and-white reading becomes easier through maturity, practice, kinesthetic reinforcement, or a combination of the three.

If phonetic books become too hard and delay affects morale, color-coding books is one option, albeit a time-consuming one, that lends itself more to remedial work than to work with groups. The time could be well spent, though, if it means the difference between reading and not reading. It's generally agreed that children learn to read by reading as widely as possible and that having a variety of books available is needed if they are to progress beyond the decoding stage (Chall, 1983). If a remedial child can read more

widely and more fluently in color, if he can practice comprehension, interpretation, sounding, blending, and use of context through reading more books, then coloring non-consumable materials for him may be worth the time and effort. To avoid overdependence on color, however, he should probably also be practicing black vowels and a controlled number of basic words in black to prepare for the time when transfer becomes feasible.

If books are color-coded, leaving the three-letter, short-vowel words black along with a few staple words like a, the, and to greatly reduces the number of words that have to be coded. The amount of work can be reduced further if only nonphonetic words are colored or only those nonphonetic words that appear to be most difficult to transfer. Giving top priority to nonphonetic words is supported by the fact that the black nonphonetic words had the highest error-scores in this study and that the greatest difference between color and black occurred with nonphonetic words, which were apparently as easy as vowel-combination words when color-coded. There are, though, a few "demon" words (like what, want, where, and were) that may be as resistant to color-coding as they are to most other instructional techniques.

As for the advisability of teaching vowels to children this age, which one must do when using a color code, vowels are often delayed if the manuals and workbooks for some of the basal programs are strictly followed. Yet these children were able to

recite without error the sounds for thirteen vowels and vowel-combinations by the tenth lesson. Thus its seems entirely possible to teach vowels to those Kindergarten and first-grade children who are at the same stage of readiness as the subjects of this study.

It may be that the use of keywords in the Gillingham manner, with the vowel pronounced in an echo relationship to the keyword (Gillingham and Stillman, 1956), helped to stabilize what Liberman (1973) called the "fluid nature of vowel perception." Neither the use of keywords nor the use of mnemonics in connecting letters with keywords was evaluated in this study, however, since there were no controls who were not using these devices. Therefore, research on these techniques is needed, but they did not seem to prevent the children from memorizing thirteen vowels and vowel-combinations in both color and black within ten lessons. If drill with vowels is tedious for children this age, the "Go Fish" games apparently overcame any antipathy they might have had for this kind of practice.

Spelling With Visual Cues

The children using the spelling-with-cues approach made significantly fewer reading errors than the control groups with vowel-combination words in black. Color apparently made more of a difference when these words were in color, but spelling with cues seemed to make more of a difference in black. Because it is a way

to map or pattern the letters in words, it may have helped the children chunk the vowel-combinations and to arrange and sequence the separate sounds in their correct order. Further testing would be warranted, since a similar task faces less advanced children reading three-letter, short-vowel words and more advanced children reading short-vowel/consonant-blend words.

Because nearly all the first-encounter spelling errors were vowel errors, it would be possible to achieve virtually error-proof spelling by devising word-sets with one vowel to a set (like book, cook, wood, and wool or food, fool, cool, and soon). Later, ear-training could be introduced by presenting a choice of two or three vowels in each word-set and helping a child with the auditory-discrimination task. Practicing auditory discrimination this way isolates it from the complicating factor of retrieving spellings, since the possible spellings can be recognized, being visible, and need not be recalled or retrieved. Also, the errorless factor can be maintained by supplying the keyword when a child has trouble with a sound.

As for the preparation of materials, the use of letter-cards is obviously practical only in tutorial situations, but putting spelling cues on the board or on paper for older children is a technique that should perhaps be tested, especially with consonant-blend and vowel-combination words.

Research

Any study of the learning process in children raises more questions than it answers. Those who advocate cutting down on the research into beginning reading because of poor test scores in the upper grades are ignoring the hard-to-measure effect that wide and enthusiastic reading in the early years can have on reading in the upper grades. As long as there is evidence that reading can be learned more quickly or more easily, the case is not closed on the subject of beginning reading, and the burden of proof should be on those who disagree.

Among the questions on phonics and color-coding are:

1 - whether or not vowels are learned more quickly and more accurately with keywords.

2 - whether it makes a difference to link colors mnemonically with keywords (in contrast to Gattegno's no keyword code).

3 - whether a vowels-only code produces different results from an all-letters code like Gattegno's

4 - whether a single color for highlighting is as effective as multiple colors with sound-cuing.

5 - whether a single color for all long vowels (as in this code) or a different color for each long vowel is more effective.

6 - whether poor blending is assisted by color-coding.

7 - whether a delayed transfer to black print is advisable for slow readers.

8 - whether a later start with no need for delayed transfer would be preferable to an earlier start with delayed transfer.

None of these questions was answered in the Gattegno studies, and except for some tentative correlations on blending, none of these questions was answered in this study because there were no control groups for the necessary comparisons.

The possibilities for errorless learning through spelling with visual cues also seems to warrant further research, especially on short-vowel/consonant-blend words, which constitute one of the major hurdles confronting beginning readers.

Another issue is the segmentation of letter sounds. The control groups in this study had their words segmented on separate letter-cards even though they did not have visual letter-cues like the experimental groups. A third group, with the words in one piece on flashcards or in print the size of the print in preprimers and workbooks would have provided an additional comparison.

Thus, further questions are:

1 - whether spelling with visual cues would make a difference with short-vowel/consonant-blend words.

2 - whether there is a difference between unsegmented words and the two approaches in this study (segmented words with visual cues and segmented words with synthetic sounding).

3 - whether spelling with cues would be helpful with three-letter words for children who are less advanced than the children

in this study.

4 - whether starting with one vowel to a word-set would make a difference in reading or spelling.

5 - whether it would be helpful when doing written spelling to use cues on the board or on paper rather than on letter-cards.

6 - whether using visual cues influences spelling as well as reading scores.

Much of the aforementioned research would provide answers that would be more beneficial for learning-disabled children than for facile beginners, but for the large number of children who fall between these two extremes, improvements in approaches to beginning reading can result in reading more easily, more widely, and perhaps more enthusiastically.

REVIEW OF THE LITERATURE ON COLOR-CODING AND WORD TECHNIQUE

Two separate problems have been studied in this experiment, along with two of the many methods available to alleviate them. One is the problem of letter technique, how to tighten the associations between letters and their sounds and how to translate the multiple and often irregular spellings of English vowels, and the other is the problem of word technique, how to help children blend, sequence, and synchronize letters and sounds when they join together in words. The two problems and the two methods studied here, color-coding vowels and spelling with visual cues, are as interdependent as letters and the words they create, but they can be studied separately as well in the same way that sounds can be segmented from words. The differentiation between the two issues is especially evident in the research on beginning reading.

COLOR-CODING

Color-coding, which is essentially a vehicle for improving letter technique, can be used for highlighting (with single rather than multiple colors), sound-cuing without keywords (as in the Gattegno code), and mnemonic prompting (as in the Bannatyne code and this one). Because all three of these uses are aspects of cuing, research on the cue value of color may actually be directed toward quite divergent purposes. These purposes are often (but need not be) mutually exclusive. For example, using color for mnemonic prompting, as in this experiment, includes both highlighting and sound-cuing, but using color for sound-cuing can exclude the

mnemonic factor (as in the Gattegno code), and using it for highlighting the visual peculiarities of letters can exclude both sound-cuing and mnemonic prompting. Therefore it's necessary to evaluate the research in terms of one's purposes for using color in learning.

Otto and Askov (1968), in a review of research on the use of color in learning, found the research to be inconclusive, stating that the cue value of color is fragile and is apt to be superseded by other types of cues. They cited findings that children tend to prefer color when they are younger, then switch to a preference for form as they grow older and that subjects depended more on secondary color cues when primary stimuli were highly similar. These findings would suggest that, when using a color code, highly similar words should perhaps be color-coded longer than visually distinctive ones.

Research by Melkman, Koriat, and Pardo (1976) and Peterson (1976) reveals an early stage of form preference in two-year-olds, which precedes the color preference of children from three to five, while May, Oliver, and Fernandez (1976) saw progress from form to mixed responding. Thus a sequence of form, color, form, then mixed responding emerges, although it is uncertain how much these stages result from maturation and how much from form-based symbolic functioning in school. Peterson cited findings that deaf children, illiterate adults, and, for some reason, older boys prefer color

to form and that, in Zululand, unschooled children and adults showed "an overwhelming preference for color" compared to children with schooling and literate adults. Melkman called color preference "a more primitive mode of functioning," and Peterson associated it with impulsive cognition, while May found that form-dominant children performed better at reading-type tasks like matching letters and words.

In describing Gattegno's Words in Color (1962), Otto and Askov wrote that the Bannatyne code differed in detail rather than principle from the Gattegno code. Actually, while Gattegno and Bannatyne agree on the principle of one color for each sound, no matter how that sound is spelled, there are differences in more than detail between the two codes. For one thing, the Bannatyne code, along with the code used in this study, extends only to vowel sounds, with the consonants black, while the Gattegno code includes colored consonants as well. Lockmiller and Di Nello (1970) found the previous research on the Gattegno code to be inconclusive and, in their experiment, found no significant differences in achievement between Words in Color and the Houghton-Mifflin Basal program. What noone seems to have investigated is whether a clear distinction between vowels and consonants, through keeping the consonants black, would make a difference compared with having the consonants also colored as they are in the Gattegno code.

Another difference not accounted for in the research is the fact that the colors in the Gattegno code are not mnemonically connected with their vowel sounds as they are in both the Bannatyne code and the one in this study. In the Gattegno code, white (on a chalkboard or black chart) indicates the short a sound; the connection must be memorized by rote, and one may not speak of letters by their names. For short a in the other two codes, blue indicates the keyword azure in the Bannatyne code, and red indicates the keyword apple in this code. Thus, what was not investigated in the Gattegno studies was the mnemonic attributes of color-coding as opposed to the rote memorization of colors and sounds (a paired-associate task) or the matching of colors that have not been associated with their sounds.

With the use of keywords, a connection between the color of a letter and its sound can be made. The connection between the shape of a letter and its sound, however, is still left to rote memorization without further mnemonic devices (such as making the letter u into the handle of an umbrella) that link form with sound to facilitate transfer to black-and-white reading. Therefore, questions about transfer remain.

The issue of transfer from a color code was studied by Lyczak (1976), who had three groups of graduate students learn sixteen Thai syllables. These contained four consonants and the same vowel for all sixteen syllables, which had four possible pronunciations

(sawn, lawn, sawt, and lawt); each consonant character had a different pronunciation, depending upon whether it was at the beginning or the end of the syllable; and the color code, when it was used, consisted of four colors for the four possible consonant sounds. The single vowel remained black, reversing the pattern of the vowels-only color code. Thus the subjects were presented with a complicated decoding task that recalls the ambiguities of sounding the or and ar in warm, warrior, dollar, born, and horror, in which each sound has two possible spellings and each spelling has three possible sounds. Moreover, unlike the consonant clues in English words, the single vowel in the middle of these Thai syllables provided no clues.

The subjects were divided into three groups: a color-trained group, using colored consonants; a shape-trained group, using black consonants; and a special group using colored consonants but trained only in the shapes of the letters. The color group were taught which color went with which sound in which position; and the special group were also told, like the color group, that letters of the same color always had the same sound. Thus the special group were not taught the color-sound associations, but they were free to figure them out.

The color group learned the syllables more quickly than the black group, but in the transfer task with black syllables, the black group performed better than the color group. The special

shape-trained color group on average learned less quickly than the color group but performed as well as the black group in the transfer task (in addition to learning twice as quickly). In fact, some members of the special group learned as quickly as the color group, perhaps because they used a different strategy from the one used by other members of the same group. The implications cited were that color-coding letters can facilitate learning, but it does not solve the problem of transfer to black and white unless there is training in form as well as color. As Lyczak pointed out, selective learning is unavoidable in a redundant-cues approach and can retard the acquisition of reading by diluting what the subjects know about form, whether the selection is due to the stimulus preference of younger children or to training in color without transfer training in letter forms. (In English, it's possible that training in vowel spellings is more crucial to transfer-training than training in letter forms.) Another implication of this study, however, is that this diluting effect can be avoided, since the special group were not prevented by attention to color cues from attending to the primary stimulus but instead were able to learn the letter-forms as efficiently as the black group and learn them faster as well. Thus training in form apparently facilitated the transfer to black letters.

The need for training in form as well as color when using a color code probably applies to teaching English as well as Thai.

In English, however, most ambiguities occur in translating our numerous and often irregular vowel spellings, so that a vowels-only code would make more sense than a consonants-only code. Also, if a vowels-only code is used, transferring to black and white may be easier than it was for Lyczak's graduate students, who used a consonants-only code. The elimination of color left the color-trained subjects with a familiar vowel surrounded by unmemorized consonants, while students using a vowel code would be left with an unmemorized vowel surrounded by familiar consonants. A glance at words like yet and clam would indicate that guessing at the unknown letters in y-t and cl-m would be easier than guessing at the unknown letters in -e- and --a- (especially with assistance from the context) and that transferring out of a vowel code would be easier than transferring out of a consonants code. On the other hand, the task of learning to spell the vowels in English words, both phonetic and nonphonetic, would not be helped by the colors that translate their sounds for reading.

As for the clues provided by the consonants in words like yet and clam, Liberman (1973) found that one-hundred third-graders made twice as many vowel errors as consonant, but it was her opinion that consonants carry most of the information load, while vowels can be corrected with help from the context. Thus a transition from a colored-vowel code (or from i.t.a.) could in practice be easier than Lyczak's findings would suggest, even without careful teaching of

the forms or spellings of the letters, although forms and spellings are needed for writing and also for the overlearning that is essential for distinguishing visually and phonetically similar words.

Lyczak's most successful group made use of both color-cues and knowledge of the shapes of the letters, but his students were graduate students, not first-graders, and were perhaps better able to attend to two types of stimuli. Goodman and Cundick (1976), however, tested colored and black letters with children from grades two, three, and four, using variations of fourteen modified Hebrew letters. As in the Lyczak experiment, learning was faster in color, but unlike Lyczak's subjects, Goodman's forty-eight children recalled more black letters after learning them in color than they did in the all-black condition, even though they received no special training in shape. Nevertheless, the children had difficulty during the transfer task, and some of the initial advantage of the color group was reduced. Thus Lyczak's conclusion that letter shapes are not automatically memorized was actually supported by Goodman's findings and applies to the teaching of children as well. Goodman noticed that color aided the learning of visually similar shapes, especially those that differ in orientation, but suggested that progressive fading of the colors might lessen the transfer problem as children gradually place greater reliance on the shapes of the letters.

Allington (1974-1975, 1976) is another advocate of fading, except that he used vanishing instead, so that the color reduced in size instead of fading in intensity. Using stimuli that resembled English orthography, three groups of Kindergarten children (thirty-four in each group) were tested on stimuli that were black on white for all three groups but had distinctive features highlighted in orange for the second and third groups, while the orange color was gradually vanished for the third group. He found that the vanishing treatment produced significantly better results than the other two treatments and concluded that the use of color to highlight distinctive features, along with the vanishing treatment, can minimize common perceptual confusions. He also hypothesized that using a single hue rather than multiple color-cues prevented the subjects from attending to the color-cue rather than to the primary stimulus of letter-shape, thereby facilitating transfer to black and white as multiple cues would not have done. While his results support the effectiveness of vanishing when using his artificial letters, he did not actually compare multiple color-cues with a single color-cue, so it is not clear whether it was the vanishing alone or a combination of vanishing and the single hue which caused the significant difference. Vanishing with multiple colors could have produced similar results.

Allington's single-color technique emphasized hard-to-distinguish visual characteristics in his letter-like figures,

providing assistance for the visual-discrimination aspect of memorizing letters. Lyczak's use of color, however, filled a sound-cuing function, since his subjects had to remember which sound went with which letter in which position. Thus a single color can highlight the visual peculiarities of the letters, but it won't help as a cue to each letter's different sounds. For example, a single color could highlight the small line that distinguishes the ar from the or in farm and form, but it does nothing to cue the learner to the different sounds of ar in barn, warm, and dollar. For this reason, sound-cuing seems more helpful than Allington's highlight-and-vanish use of color for the rote-memory task of decoding English vowels, since it can reduce the numerous and often irregular spellings of English vowels to as few as eighteen stimuli (and thirteen colors*).

Since the vowel letters are small in number, with o and a the only two that are visually similar, Allington's use of color may be unnecessary for vowels as individual letters. On the other hand, having a contrast between black consonants and colored vowels may

*Since the long vowels themselves are cues to their own sounds without need for keywords, having the long vowels share the same color and also having a two-tone i that shares colors with two other vowels reduces eighteen sounds to thirteen colors. Separate colors for ar and or could have been dispensed with as well, but the advantages of chunking these two sounds seemed to justify having two additional colors. The sound of the a in stare is not strictly a long a sound but seems close enough to make an additional color unnecessary. In the British version of this code, however, the are in stare has a separate color, while the or and aw in horse and saw share the same color.

serve to highlight the vowel portion of each word, forcing attention to the interior of each syllable and helping children to chunk the vowel-combinations. According to Marchbanks and Levin (1965), it is the interior portions of words that children tend to notice last, so this highlighting could facilitate left-to-right decoding even if multiple colors are used.

When color is vanished from a letter in a visual-discrimination task, the whole letter is colored in the first phase and only part of it is colored during the vanishing. With colored vowels, however, the whole word is not colored during the first phase, so that removing the color from the entire vowel or diphthong is not such an abrupt withdrawal of the color. As Liberman observed, the consonants provide clues to many words whether the vowel is correctly identified or not. Thus it's possible that children reading with color-coded vowels do their own fading or vanishing as they increasingly ignore the vowel each time they encounter a word, so that by the time of transfer to black the color is superfluous, at least when transfer isn't accomplished before this fading can occur. A test of this process might be hard to carry out, but it could shed light on the issue of transfer for i.t.a. as well as color-codes.

As for distinguishing the visual peculiarities of the more numerous consonants, Liberman (1973) cited research supporting the idea that the visual identification of the letters, most of

which are consonants, poses little difficulty for most children by the end of the first year of schooling, whereas vowels elicit more errors than consonants. Thus it's possible that reserving the use of colors for the vowels would not be a great disadvantage when teaching the consonants. For initial learning of consonants (in isolation, not in words), an alternative to color highlighting can be using picture clues (like a ladder attached to the letter l) as was done in this experiment. These can also be vanished (made into rudimentary pictures) if necessary. In addition, a picture like a ladder provides a mnemonic link between the shape of a letter and its sound, whereas color as Allington used it provides highlighting without mnemonics. Anyone comparing the use of highlighting with the use of pictures would also have to keep in mind the fact that vowels and consonants would be harder to distinguish from each other if both have color cues.

What is also open to investigation is whether any form of cue, whether colors or pictures, can help young or disabled children to distinguish the letters b and d or whether these cues only make these letters usable until confusion is resolved by a combination of maturity, cursive script, and cues like having the letters embedded in familiar words (hard is a word; harb is not).

These issues have not been considered in the Gattegno studies. Therefore, if the use of color in reading is to be evaluated properly, the following questions need to be asked: Does

highlighting vowels but not consonants, with one or multiple colors, facilitate reading even without the sound-cuing function of keywords? Is a single color less distracting than multiple colors from the standpoint of highlighting? Is the sound-cuing function of a color code more or less helpful than the visual-discrimination (highlighting) function? And is mnemonic sound-cuing with keywords any more helpful in color-coding than sound-cuing without keywords?

Another issue is that of errorless learning. Methods like color-coding, i.t.a., and vanishing are all "errorless" techniques, designed to minimize mistakes in the earliest stages of reading and to foster rapid progress in these earliest stages. In an experiment with errorless learning, McDowell (1982) tested a Prompting-and-Fading technique for teaching fifteen sight words to thirty Kindergarten children, using picture-prompts and sight words rather than colors and phonics, but his results are relevant to the study of any rote-memory task, including the memorization of keywords. As with Lyczak's color group, McDowell's prompting-only group learned faster and transferred less well than the no-prompt group. The prompt-and-fade group combined good transfer scores with almost error-free learning, while the no-prompt group made many errors at first, but the errors gradually declined. Because prompting was a more expensive and complicated method and because the no-prompt children, through trial-and-error, eventually

achieved scores that were similar to the prompt-and fade scores, McDowell questioned whether trial-and-error isn't ultimately just as effective as prompting and fading, without the more expensive and complicated materials. (His materials included a slide-projector and a rotary switch for the fading rather than the less complicated crayons and index cards used in this experiment.)

His no-prompt group might not have learned (or retained) a larger number of words than the fifteen that they learned, but the central question remains: is it possible to assess unquantifiable attributes like confidence, enthusiasm, and habits of accuracy and, if so, does errorless learning foster these attributes better than trial-and-error learning, or does ultimate success after a period of trial-and-error produce them just as well? Learning-disabled children pose a special problem which McDowell didn't consider, since they tend to make errors even when using errorless techniques and to prolong trial-and-error tasks beyond the point of diminishing returns. For these children, is time saved by preparing less complicated materials subsequently wasted because learning time is prolonged by tasks not carefully structured for success?

WORD TECHNIQUE

While color-coding is one solution to the problem of letter technique, it contributes little to word technique. For a child to use the letter-sounds he has memorized, he needs to be able to map

or pattern the visual sequence of letters in a word onto its already familiar spoken sequence of sounds. However, as Liberman (1973) observed, the necessary awareness of the phonemic structure of words is not readily available to the child and was apparently not readily available to the human race, which produced syllabaries and picture-word systems thousands of years before its only alphabet. In fact, among children with reading disabilities, many continue to have trouble with sound-segmentation tasks like rhyming and Pig Latin, revealing difficulty with separating and recombining the separate sounds or phonemic segments of words. In contrast, she cited the ease with which Japanese first-graders are said to master kana (a syllabary) and the fact that reading-disabled children have learned kanji-like (pictographic) representations while being unsuccessful with alphabetic reading.

One explanation for this difficulty with letters, according to Liberman, is the way that the initial and final consonants in a word or syllable are "folded into the medial vowel," so that the segments are transmitted (and probably perceived by the child) as one acoustic segment. To understand speech the child need not be any more aware of phonemic structure than he is of the rules of syntax, but to read and spell he needs for the first time to become conscious of this structure.

Using a tapping game, Liberman compared the ability of four, five, and six year olds to tap out the phonemic segments of spoken

words with their ability to tap out the syllables. While their identification of individual letters was significantly less accurate than their identification of syllables, their efficiency in both tasks increased with age, but Liberman was unable to judge how much the increases in phonemic segmentation could be attributed to maturation and how much to instruction in reading. In a follow-up study the next year, she also found that their reading achievement was consistent with their ability or inability to tap out the letters the year before. In another experiment with three-letter words, twenty third-graders made twice as many errors with final consonants as with initial consonants and twice as many errors with vowels as with consonants. These findings are in agreement with those of Marchbanks and Levin (1965), whose one-hundred Kindergarten and first-grade children also recognized more words by individual letters than by configuration. Liberman attributed the consonant errors to difficulty with mapping "the segmentation of the printed word to the segmentation of the spoken word" but attributed the vowel errors to both the complexity of vowel spellings and to "the continuous and fluid nature of vowel perception," as illustrated by the variations that exist among dialects and the resulting variations in vowel spellings. Thus, while vowel errors would be a problem of letter technique (a problem for which color-coding is a possible solution), consonant errors can be a problem of word technique, for which

segmentation and "mapping" or patterning procedures like auditory-to-visual spelling should be investigated.

While Liberman studied the segmentation of sounds in words, McNinch (1981) studied the segmentation of words in sentences and added a dimension of visual representation that is analogous to the visual aspect of spelling with visual cues. Like Jansky (1981, 1982), he noted the difficulty young children have with determining the boundaries between words in sentences, a form of segmentation that probably precedes in the child's development the segmentation of syllables and sounds that Liberman studied. In McNinch's experiment, one group of children heard words and phrases spoken in normal conversational manner; another group heard them with one-fifth-second pauses between them; a third group heard words without pauses but saw them written with spaces between them to mark their boundaries visually; and a fourth group had both pauses and visual representations.

In a procedure similar to Liberman's tapping game, McNinch's fifty-eight Kindergarten children laid down plastic counters for each word that they heard. The children counted more separate words when they were spoken with pauses between them, but what contributed new data was that the auditory-plus-visual groups did better than their corresponding auditory-only groups, suggesting that "combinations of auditory and visual cuing heighten the perception of each word as an individual unit." The addition of

the visual element to an auditory segmentation task is relevant to this study, since it's possible that the auditory-to-visual mapping of letters in A-V spelling has an effect on letter-segmentation similar to the way mapping the words had an effect on McNinch's word-segmentation.

The practice of combining the auditory and visual modalities has a long history, which includes integrating the speech and tactile-kinesthetic modalities with the auditory and visual. Orton (1937) and Gillingham and Stillman (1956) both stressed the need for intersensory learning and for learning to read through learning to spell. Spalding (1957) found that children became proficient readers when they learned their words through phonetic spelling and through writing the words that they spelled, after having memorized and practiced the vowel and consonant sounds in a way that is comparable to the Gillingham method. The Spalding approach is essentially a words-to-letters method, which is actually a modified synthetic, alphabetic method (Mathews, 1966, pp. 63 and 186). The Spalding approach to reading-through-spelling is similar to spelling with visual cues in that it circumvents the necessity for blending and proceeds from whole words rather than phonetic fragments of words. It is a more rigorous method, however, since the children write their words instead of constructing them out of letter cards and since the children must recall the spellings of the sounds without having visual cues, which merely require

recognition rather than total recall.

With any phonetic method, blending becomes an issue. Orton and Gillingham both stressed its importance, while, more recently, Liberman (1973) and also Fayne and Bryant (1981) discussed the need to eliminate the intrusion of the schwa (*buh-a-tuh* for *bat*). According to Fayne and Bryant, a decoding strategy that clusters letters into units alleviates the intrusion of the schwa and reduces the number of elements to synthesize. Comparing three sounding approaches (c-o-t, co-t, and c-ot), they found that beginners transfer initial-bigram patterns (co-t) to novel words better than final patterns (c-ot) or unrelated patterns (c-o-t), focusing more often on the initial consonants (as Marchbanks and Levin found in 1965) in a way that is contrary to the common practice of teaching through rhyming words. It may be that rhyming words are more often used because many rhyming "word families" have more members, while beginning-bigram families are usually limited to only four or five high-frequency words (like *back*, *bad*, *bag*, and *bat*).

Teaching with bigrams like the *co* in *cot*, however, means dealing with fragments of words that are even more meaningless than individual letters, which at least can be made meaningful by associating them with keyword pictures and even by superimposing keyword pictures on the letters as with embedded-letter pictures. In contrast, when using a spelling approach like Spalding's or spelling with visual cues, the letters are preblended and preclustered

and presented in meaningful words, after which the child can reblend the letters, when reading the words he has just spelled, while the words are still fresh in his mind. (The transfer to reading without spelling, of course, requires repetition and over-learning for children who are slow to memorize words.)

As for the difference between the total-recall spelling needed for the Spalding approach and the recognized-letters spelling needed for spelling with visual cues, Bannatyne (1974) considered total-recall spelling to be essential, since it involves overlearning rather than the mere recognition of letters which occurs during reading. The auditory-to-visual spelling (spelling with visual cues) tested in this experiment involves a recognition process and thus constitutes an intermediate step between non-spelling and total-recall spelling. What was investigated in this study is whether it facilitates the acquisition of total-recall reading, and what also needs to be studied is whether it facilitates the acquisition of total-recall spelling. The question is analogous to whether color-coding facilitates the acquisition of black-and-white reading. In other words, does one use color while training for form and use recognition while training for recall, or is it better to move directly to form and recall without intermediate strategies? From the transfer scores in this study, it would seem that these intermediate strategies may indeed be useful.

SUMMARY

The research on color-coding in beginning reading is mainly divided between highlighting and sound-cuing, but its mnemonic aspects seem to have received little attention, partly because the use of mnemonics was not part of the Gattegno code and the research that was focused on this code. In a vowel code, for which sound-cuing is the principal purpose, the highlighting function of color has to be limited to the way it can set vowels off from consonants. However, the fading and vanishing that go with highlighting can be applied to the withdrawal of color from the vowels, while black and white pictures (like showing a u as the handle of an umbrella) can be vanished as easily as colors. Pictures like this can emphasize the visual peculiarities of the letters the way highlighting does and can serve a mnemonic function as well. It's also possible that clues from the pattern of consonants in a word can foster a kind of spontaneous fading in the colored vowel, so that a child comes to ignore the color and ceases to depend on it. This situation probably occurs more often in delayed transfer, when coding with color outlives its usefulness. For achieving transfer at an earlier stage, however, the research points clearly to the need for transfer training in black letters to avoid overdependence on the secondary cues. Therefore, in this study, transfer training in black vowels was an essential element in the experimental design.

The research on word technique in beginning readers seems to be divided into three areas: what elements children focus on when learning words, what pattern of blending seems easiest for them, and what their perception is of the phonemic structure of words. The approach to words by the children in this experiment was not inconsistent with the findings that children this age focus on letters more than words, consonants more than vowels, and initial more than final consonants. What was particularly relevant to the spelling-with-cues approach was the research on phonemic structure and the segmentation of sounds in words (which is actually a rudimentary form of spelling) and the research on the segmentation of words in sentences. The finding that children's ability to peel or segment the sounds in words increases with age and varies with aptitude for reading suggests that assistance with this process through techniques like spelling with visual cues may be needed for young or disabled beginners. Research on the analogous segmentation of words in sentences introduces the visual element for segmenting words just as spelling with cues introduces the visual element for segmenting letters. That combining auditory and visual cues heightened the perception of words as individual units and that separating them visually helped segmentation is in keeping with the "errorless" aspect of spelling with visual cues.

Although the research on letter technique and word technique is well differentiated, the two issues are hard to separate when one is teaching. What they have in common in this study is not only the interdependence of letters and words but also the way both issues lend themselves to errorless-learning techniques. While the research on errorless learning seems to have focused on the problem of transfer from "errorless" to unprompted conditions and the problem of preparing special materials, the results of this study suggest that transfer can be accomplished without a reduction in efficiency if transfer training is not neglected. As for the complication of preparing special materials, individual pupils and their requirements are more various than the subjects and the purposes of research studies, so that the times when need justifies effort must inevitably be left to the discretion of the teacher.

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APPENDIX A

LESSON PLANS AND VOWEL GAMES

LETTER PHASE

Lesson 1 -

Consonant game 1 (f, h, m, p, t)

Picture-match short vowels*

Vowel game 1

Lesson 2 -

Consonant game 2 (c, g, n, r, s)

Picture-match short vowels again

Vowel game 1 again

Consonant game 1 again

Lesson 3 -

Consonant game 3 (k, l, v, w, h)

Picture-match short vowels again

Vowel game 1 again

Consonant game 2 again

*Picture-matching involves:

1 - matching black keyword pictures to colored vowel cards, using the composite picture with colored keyword-pictures for reference.

2 - for each vowel, having the child pronounce first the keyword, then the sound, in an echo relationship to the keyword.

3 - having the child spell the vowels, using an auditory-to-visual approach ("Which one is /a/?", etc.)

4 - having the child pronounce the keywords and sounds with the black keyword pictures removed, using the composite picture for reference when necessary.

Lesson 4 -

Consonant game 3 again

Vowel game 4

Picture-match ar, or, and ir

Vowel game 2

Lesson 5 -

Consonant game 2 again

Picture-match ar, or, and ir again

Vowel game 2 again

Vowel game 5

Match consonants and pictures in games 1 and 3 without playing the games (for review)

Lesson 6 -

TEST the consonants, both reading and multiple-choice spelling

Picture-match ow, oy, al, and both sounds of oo

Vowel game 3

Vowel game 7

Consonant games for missed consonants (if any)

Lesson 7 -

Consonant games for missed consonants (if any)

Picture-match ow, oy, al, and both sounds of oo again

Vowel game 3 again

TEST short vowels (colored letters)

Practice short vowels (black letters and color swatches)

Vowel game 6

Vowel game 7 again

Lesson 8 -

Consonant games for missed consonants (if any)

TEST short vowels (black letters and color swatches)

TEST all but short vowels (colored letters)

Practice all but short vowels (black letters and color swatches)

Vowel game 8

Vowel game 7 again

Before lesson 9 (the Word Phase), each child was tested on all but the short vowels (black letters and color swatches), then assigned to one of the four treatment groups.

WORD PHASE

Lesson 9 -

Read black vowels and color-swatches*

Vowel game 8 again

Start word-sets A and B (letter-packets and word-matching)

Consonant game 1

Lesson 10 -

Read black vowels and color-swatches*

Reteach word-sets A and B (letter-packets and word-matching)

Vowel game 8 again

Consonant game 2

Lesson 11 -

Read black vowels and color-swatches*

TEST word-sets A and B

Start word-sets C and D (letter-packets and word-matching)

RETEST word-sets A and B in black (color groups only)

Consonant game 3

Lesson 12 -

Read black vowels and color-swatches*

Reteach word-sets C and D (letter-packets and word-matching)

Consonant game 1

*color-swatches for color groups only

Lesson 13 -

Read black vowels and color-swatches*

TEST word-sets C and D

Start word-sets E and F (letter-packets and word-matching)

RETEST word-sets C and D in black (color groups only)

Consonant game 2

Lesson 14 -

Read black vowels and color-swatches*

Reteach word-sets E and F (letter-packets and word-matching)

TEST word-sets A' and C' (untaught words)**

Consonant game 3

Introduce extra consonant game (b, d, j, q, w, y, z)

Lesson 15 -

Read black vowels and color-swatches*

TEST word-sets E and F

TEST word-set E' (untaught words)**

RETEST word-sets E and F in black (color groups only)

Extra consonant game again

* color-swatches for color groups only

** color groups in color, black groups in black

VOWEL GAMES

For games 1, 2, and 3, the composite picture for the color code (with colored keyword-pictures) was used for reference.

Game 1 - short vowels - three colored letters to a book

Game 2 - ar, or, and ir - three colored letters to a book

Game 3 - ow, oy, al, and both sounds of oo - three colored letters to a book (the l in al circled because it is silent)

For games 4 through 8, three composite pictures with the vowels embedded in colored keyword-pictures were used for reference. The cards in these games were matched before playing each game so that mnemonic connections could be explained.

Game 4 - short vowels - one black letter and one embedded-letter picture to a book

Game 5 - short vowels plus ar, or, and ir - one black letter and one embedded-letter picture to a book

Game 6 - ow, oy, al, and both sounds of oo - one black letter and one embedded-letter picture to a book

Game 7 - short vowels plus ar, or, and ir - one black letter, one black keyword-picture, and one color-swatch to a book (keyword pictures without embedded letters)

Game 8 - ow, oy, al, and both sounds of oo - one black letter, one black keyword picture, and one color-swatch to a book (keyword pictures without embedded letters)

APPENDIX B

COLORS, KEYWORDS, AND PICTURES

LIST OF KEYWORDS AND COLORS

a - apple - red

e - elephant - pink

i - Indian - black with a red dot
The Indian wears a black shirt and red feathers

o - olive - light green (Crayola's yellow-green)

u - umbrella - gray
On a gray day, you carry an umbrella.

or - horse - brown

ar - star - gold (Crayola's maize)
gold like a sticker

ir - bird - blue
like a blue jay

ow - cow - purple
"I never saw a purple cow;
I hope I never see one,
But I can tell you anyhow,
I'd rather see than be one."

oy - boy - dark blue (ink)
The boy wears dark blue jeans.

oo - moon - yellow

oo - book - bold black with a rectangle (book) on top

al - walk - dark green (Crayola's plain green to be "traffic-light" color)
When the traffic light is green, it's all right to walk.

Long vowels are orange; silent letters are circled; and irregular consonants have a red line under them and a respelling on top.

LIST OF KEYWORDS FOR THE TRANSFER TO BLACK

a - apple - round like an apple with a little stem on it

e - elephant - The scoop on the e is the elephant's trunk.

i - Indian - The dot is his head (in color, his red feathers)

o - olive - round like an olive

u - umbrella - The u is the handle on the umbrella.

or - horse - The horse is looking at a rainbow. The o is his big, round eye

ir - bird - The bird is also looking at a rainbow. The i is his little dot for an i (smaller than the horse's).

ar - star - The star and the rainbow are both in the sky. The line on the a is a sparkle on the star.

ow - cow - The o is a glass of milk, and the w is her horns.

oy - boy - The boy is reaching up to catch his ball.

oo - moon - Mars has two moons.

oo - book - glasses for reading the book

al - walk - The l is the traffic light that tells you when to walk.

a
e
u
i
o
or
ar
ir
ow
oo
oo